# ARNOLD WARE'S CRANE ACCIDENT (A)

The boom brake adjusting bolt broke on a crane. The boom fell and injured Mr. Arnold Ware severely. Mr. Ware sued the manufacturer and the operator of the crane. Part A describes the accident and the boom control system on the crane involved in the accident.

Some names disguised

 Prepared for the Stanford Engineering Case Program by Mr. R. Ganeriwal under the direction of Professor Henry O. Fuchs with financial support from the National Science Foundation. The cooperation and assistance of the law offices of Goodman, Eden, Robb, Millender, Goodman, and Bedrosian is gratefully acknowledged.

# ARNOLD WARE'S CRANE ACCIDENT (A)

On December 11, 1964, the construction workers of the LSK Engineering Company began their morning as usual at the construction site of the bridge at Poway Road and Highway 395 in San Diego, California. At first it appeared that this would be another normal day, a day toward the completion of the bridge. Exhibit A-1 shows the construction site.

At approximately 8:15, however, as Marvin E. Daves, the crane operator, started to lower a bucket of cement, the crane boom suddenly dropped onto the bridge and struck Mr. Ware on the head. Arnold Ware, an employee of the LSK Engineering Company, was helping to dump and spread wet cement as it was being lifted onto the bridge surface by the crane. As the boom fell, it struck Mr. Ware on the head and then it landed on the top of the cement bucket which had come to rest on the bridge. The fact that the boom had come to rest on the bucket after it struck Mr. Ware saved him from being crushed. The blow to his head caused a fracture of his spinal chord and rendered him paralyzed from the middle chest down. The injury has left Mr. Ware with the use of his arms but he has no control over his legs, or intestinal or urinary tracts. As a consequence, a suit of negligence was brought against the Cloverdale Crane & Rigging Company and the Hans Roverson Crane Company. The crane was manufactured by the Hans Roverson Crane Company of Atlanta, Georgia, whereas the Cloverdale Crane & Rigging Company was the owner and the renter of the crane.

## DESCRIPTION OF THE HANS ROVERSON CRANE INVOLVED

The schematic sketches on pages 1 and 3 of Exhibit A-2 give visual description of the crane involved in this case. It is a mobile crane designed to be transported by its own self-contained truck over most highways.

The HO-8A model, Serial Number 9HS 3512, the crane involved in this accident, was built by the Hans Roverson Crane Company in 1958. It is rated as having a 40 ton lifting capacity at 12 ft. radius (Exhibit A-2, page 2).

At the time of the accident, the crane was being operated with a 90 ft. main boom and a 30 ft. jib. The main boom is the arm which attaches to the base of the crane, while the jib is that attachment which can be placed on the remote end of the boom in order to give the crane greater reach. (See Exhibit A-2, page 2)

Investigation of the crane subsequent to the accident revealed a failure of a part in the boom brake assembly. The operation of the HO - 8A in terms of three basic controls, including a detailed description of the boom brake control system, are given in the following section.

## OPERATION OF AN HO-8A CRANE

There are three main controls which operate a crane of this type:

a. The crane lever is the control which causes the whole crane unit to rotate. The crane can be rotated 360 degrees around its base on the truck frame.

b. The load line control raises or lowers the crane's load. The load line is the group of cables which is suspended over the end of the boom or jib.

c. The boom control raises and lowers the boom causing the boom to assume a more vertical or a more horizontal position. The schematic sketch on page 3 of Exhibit A-2 shows the boom in a number of positions.

## BOOM CONTROL SYSTEM

Exhibit A-3 shows location of the boom hoist shaft assembly with respect to the engine and other main operating parts of the crane.

The boom is operated by rotation of a drum on which cables are wound. This drum in turn is controlled by three assemblies, operating on the boom hoist shaft. These are the "booming up" clutch, the "booming down" clutch, and the booming brake. Exhibit A-4 is a photograph of the control panel inside of the crane cab showing the boom control lever. When the lever is in center position, the boom brake is engaged. The boom brake prevents the boom hoist shaft from rotating, and thus the boom remains in a fixed position when the lever is in this position. When the operator pulls the boom control lever toward himself, the boom brake is disengaged and the "boom up" clutch is engaged. This causes the boom hoist shaft to rotate which, in turn, winds up the cables to which the boom is attached. This series of events raises the boom. Similarly, when the operator pushes the boom control lever away from himself, the boom brake is disengaged and the consequent engagement of the "boom down" clutch controls the rotation of the boom shaft and the boom is lowered.

## BRAKING SYSTEM

The braking system which controls the movement of the boom is connected to the boom hoisting shaft. This system is comprised of two separate units. The locations of the two on the boom hoisting shaft are marked in italics in Exhibit A-5.

(a) The first is a device called a boom dog or a safety pawl. It is a ratchet-pawl arrangement which is engaged or disengaged mechanically by the operator who must pull or push a lever in the cab. The pawl and ratchet rings can be seen on the left end in Exhibit A-5. Exhibit A-6 provides an end view with some additional details of this arrangement.

The function of the boom dog is to act as a back-up system for the friction brake (described below). In case of failure in the main boom brake, the boom is restrained from falling to the ground.

(b) The second is a friction brake, referred to as boom hoist brake. It is a spring applied brake which is engaged or disengaged depending on the position of the boom control lever as explained in the preceding section. The hydraulic pressure which actuates the "boom up" or "boom down" clutches also acts to disengage the boom brake.

Exhibit A-7 shows details of the boom hoist brake.

## BOOM BRAKE ADJUSTING BOLT

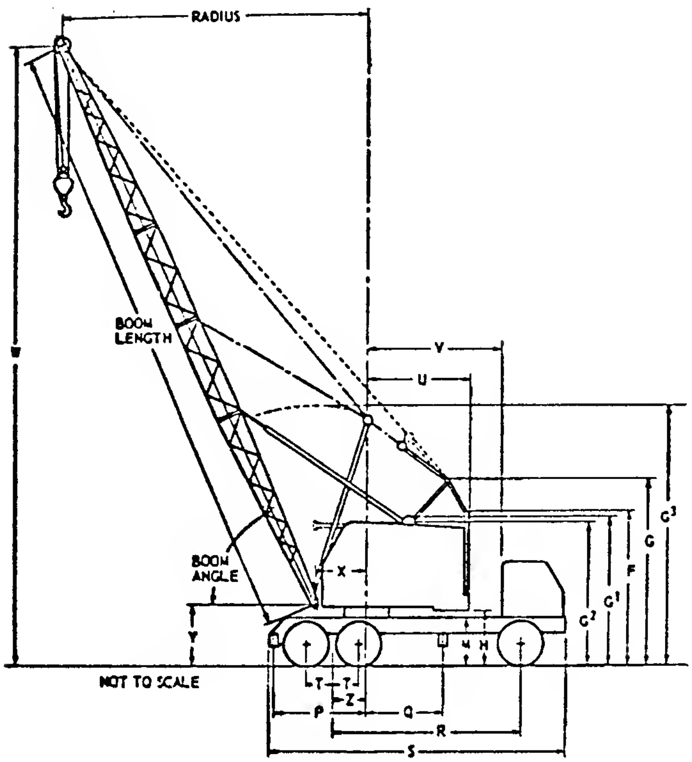
Connected to the boom hoist shaft is a brake drum (see Exhibit A-7). Brake bands are wrapped around the drum, and as these brake bands are pulled tightly around the drum the brake restrains the drum and consequently, the boom hoist shaft. Connecting two segments of the brake bands is a bolt which is referred to as the boom brake adjusting holt.
bolt

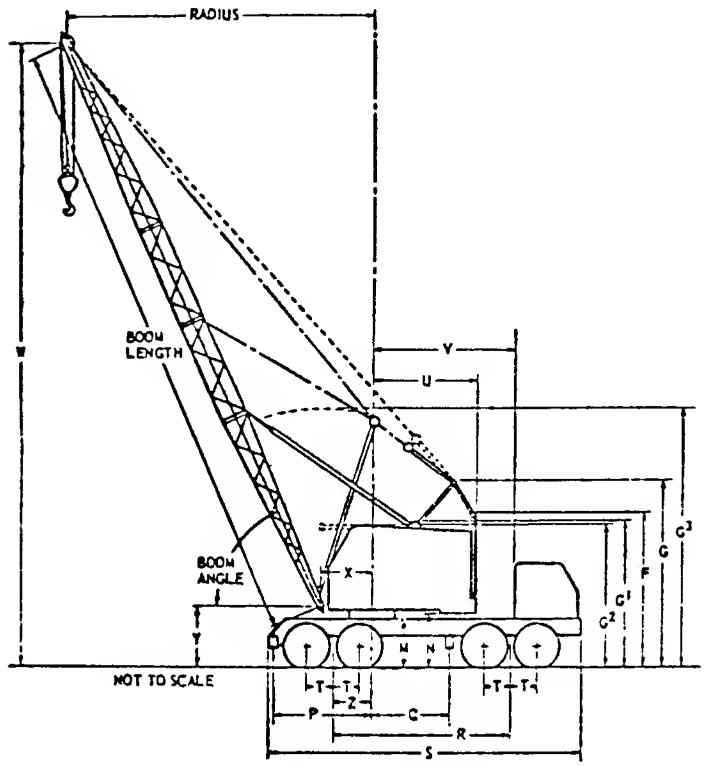
It was this bolt which broke on the Hans Roverson crane in question and consequently no braking action was provided by the boom hoist brake. The crane operator, Marvin Daves, was not using the boom dog at the time of the accident. Cloverdale Crane & Rigging Company was charged with negligence because of their failure to use the boom dog. In addition, Mr. Ware's attorneys contended that CC & RC had made alterations to the boom brake assembly, and the length of the crane boom and jib employed at the time of the accident exceeded the manufacturer's recommendations. It was claimed that the last two actions had caused the boom brake adjusting bolt to overload beyond its designed capacity and to break.

EXHIBIT A-1

Scene of the Accident

## STANDARD 3-AXLE OR OPTIONAL 4-AXLE CARRIER
# STANDARD ANGLE OR OPTIONAL TUBULAR "HI-LITE" BOOM




**NOTE:** The dotted lines indicate the standard heavy duty retractable high gantry which is used with angle booms up to and including 100' and optional tubular "Hi-Lite" booms up to and including 130'. For tubular booms over 130', the "Hi-Lite" boom gantry and mid-point suspension cables are also required①. The "Hi-Lite" boom gantry can also be furnished as optional with all tubular booms under 130'. (Reference to boom lengths are for main boom—use of optional 20', 30', 40' and 50' jibs with these boom lengths will not effect the recommendations.)

| GENERAL DIMENSIONS | | 3-AXLE | 4-AXLE |
|---|---|---|---|
| Basic angle boom length | | 40' | 40' |
| Basic tubular "Hi-Lite" boom length | | 40' | 40' |
| Over-all height heavy duty retractable gantry lowered | F | 13' 1" | 13' 3" |
| Over-all height heavy duty retractable gantry raised | G | 16' 4" | 16' 6" |
| Over-all height low gantry② | G1 | 12' 6" | 12' 8" |
| Over-all cab height | G2 | 12' 1" | 12' 3" |
| Over-all cab width | | 8' 0" | 8' 0" |
| Maximum height "Hi-Lite" boom gantry | G3 | 27' 5" | 27' 7" |
| Minimum height "Hi-Lite" boom gantry with boom horizontal | G3 | 18' 6" | 18' 8" |
| Over-all height top of ring gear plate | M | 4' 6" | 4' 8" |
| Ground clearance under counterweight | N | 4' 9" | 4' 11" |
| Centerline rotation to rear outrigger center | P | 8' 11" | 8' 11" |
| Centerline rotation to front outrigger center | Q | 8' 11" | 8' 11" |
| Truck wheelbase | R | 18' 9" | 18' 2" |
| Over-all length over rear outrigger box | S | 28' 6" | 30' 1" |
| Center of wheel to bogie pivot (rear) | T | 2' 5" | 2' 5" |
| Center of wheel to bogie pivot (front) | T | — | 2' 3" |
| Tailswing of counterweight | U | 10' 10" | 10' 10" |
| Centerline rotation to back of truck cab | V | 13' 9" | 14' 3" |
| Radius to boom hinge pin—angle boom | X | 3' 2" | 3' 2" |
| Radius to boom hinge pin—tubular "Hi-Lite" boom | X | 4' 1" | 4' 1" |
| Height of boom hinge pin—angle boom | Y | 6' 10" | [illegible]10" |
| Height of boom hinge pin—tubular "Hi-Lite" boom | Y | 5' 5" | [illegible]7" |
| Centerline rotation to rear axle bogie pivot | Z | 3' 6" | 3' 6" |
| Maximum over-all width—(over tires) | | 10' 3" | 10' 3" |
| Maximum over-all width—(outriggers extended) | | 14' 6" | 14' 6" |

## CARRIER BRIEF SPECIFICATIONS

**3-AXLE**—Heavy duty all-welded frame; 14:00 x 20, 18-ply tires—dual tires on rear tandem axles, single tires on front axle; 6-wheel air brakes. Hydraulic power steering; 6 x 4 drive; 46'6" turning radius; planetary rear axle. Standard engine —Waukesha 145GKB gasoline, 240 brake h.p. @ 2400 r.p.m. governed speed. 12 speeds forward, 3 reverse. Road speeds up to 27.6 m.p.h.
**4-AXLE**—Same as 3-axle except—front axles on equalizer beam; 8-wheel air brakes; 49'0" turning radius; 8 x 4 drive.

① See "Maximum Boom Lengths Machine Can Handle Without Assistance"—page 3.
② Low gantry available at a reduction in price for angle booms only up to and including 60'. Consult factory if capacities are required.

# STANDARD 3-AXLE OR OPTIONAL 4-AXLE CARRIER⑤

## –STANDARD ANGLE BOOM–

**RECOMMENDED FOR LIFTING CRANE SERVICE ONLY**

| BOOM | | | W. Boom Point Height | WITH OUTRIGGERS | WITHOUT OUTRIGGERS | |
|---|---|---|---|---|---|---|
| Length | Radius | Angle | | Side or Rear | Side | Rear⑤ |
| 40' | 10' | 80° | 46' 4" | 80,000 | 52,690 | 78,890 |
| | 12' | 77° | 45'11" | 80,000 | 40,610 | 59,800 |
| | 15' | 73° | 45' 1" | 70,000 | 30,010 | 43,770 |
| | 20' | 65° | 43' 3" | 49,930 | 20,650 | 29,940 |
| | 25' | 57° | 40' 6" | 35,540 | 15,540 | 22,540 |
| | 30' | 48° | 36' 7" | 27,410 | 12,320 | 17,930 |
| | 35' | 37° | 31' 3" | 22,180 | 10,100 | 14,790 |
| | 40' | 23° | 22' 7" | 18,530 | 8,430 | 12,510 |
| 50' | 12' | 80° | 56' 2" | 80,000 | 40,280 | 59,580 |
| | 15' | 76° | 55' 6" | 69,700 | 29,690 | 43,470 |
| | 20' | 70° | 54' 0" | 49,710 | 20,330 | 29,630 |
| | 25' | 64° | 51'11" | 35,290 | 15,220 | 22,230 |
| | 30' | 58° | 49' 2" | 27,140 | 11,990 | 17,620 |
| | 35' | 51° | 45' 6" | 21,900 | 9,780 | 14,480 |
| | 40' | 43° | 40' 9" | 18,250 | 8,160 | 12,190 |
| | 45' | 33° | 34' 5" | 15,560 | 6,930 | 10,460 |
| | 50' | 21° | 24' 6" | 13,500 | 5,960 | 9,100 |
| 60' | 15' | 79° | 65' 9" | 69,400 | 29,360 | 43,160 |
| | 20' | 74° | 64' 6" | 49,480 | 20,000 | 29,320 |
| | 25' | 69° | 62'10" | 35,040 | 14,890 | 21,920 |
| | 30' | 64° | 60' 7" | 26,880 | 11,670 | 17,310 |
| | 35' | 58° | 57' 9" | 21,630 | 9,460 | 14,160 |
| | 40' | 52° | 54' 4" | 17,970 | 7,840 | 11,880 |
| | 45' | 46° | 49'11" | 15,280 | 6,610 | 10,140 |
| | 50' | 39° | 44' 7" | 13,210 | 5,640 | 8,780 |
| | 55' | 30° | 37' 3" | 11,570 | 4,860 | 7,690 |
| | 60' | 19° | 26' 2" | 10,240 | 4,210 | 6,780 |
| 70' | 15' | 80° | 75'11" | 69,100 | 29,040 | 42,860 |
| | 20' | 76° | 74'11" | 49,260 | 19,680 | 29,010 |
| | 25' | 72° | 73' 5" | 34,790 | 14,570 | 21,610 |
| | 30' | 68° | 71' 6" | 26,610 | 11,350 | 17,000 |
| | 35' | 63° | 69' 3" | 21,350 | 9,140 | 13,850 |
| | 40' | 58° | 66' 5" | 17,690 | 7,520 | 11,560 |
| | 45' | 53° | 63' 0" | 14,990 | 6,290 | 9,830 |
| | 50' | 48° | 58'11" | 12,920 | 5,320 | 8,470 |
| | 55' | 42° | 53'11" | 11,280 | 4,540 | 7,370 |
| | 60' | 36° | 47' 8" | 9,940 | 3,890 | 6,470 |
| | 65' | 28° | 39' 9" | 8,840 | 3,350 | 5,710 |
| | 70' | 17° | 27' 7" | 7,920 | 2,890 | 5,070 |

| BOOM | | | W. Boom Point Height | WITH OUTRIGGERS | WITHOUT OUTRIGGERS | |
|---|---|---|---|---|---|---|
| Length | Radius | Angle | | Side or Rear | Side | Rear⑤ |
| 80' | 20' | 78° | 85' 2" | 49,030 | 19,360 | 28,700 |
| | 25' | 74° | 83'11" | 34,540 | 14,250 | 21,300 |
| | 30' | 70° | 82' 3" | 26,340 | 11,030 | 16,680 |
| | 35' | 67° | 80' 5" | 21,090 | 8,820 | 13,540 |
| | 40' | 63° | 77'11" | 17,410 | 7,200 | 11,250 |
| | 45' | 59° | 75' 2" | 14,700 | 5,970 | 9,520 |
| | 50' | 54° | 71'10" | 12,630 | 5,000 | 8,150 |
| | 55' | 50° | 67'11" | 10,980 | 4,220 | 7,060 |
| | 60' | 45° | 63' 3" | 9,650 | 3,570 | 6,150 |
| | 65' | 39° | 57' 9" | 8,550 | 3,030 | 5,400 |
| | 70' | 33° | 50'11" | 7,620 | 2,570 | 4,750 |
| | 75' | 26° | 42' 2" | 6,830 | 2,170 | 4,200 |
| | 80' | 16° | 29' 4" | 6,140 | 1,830 | 3,720 |
| 90' | 20' | 79° | 95' 4" | 48,810 | 19,030 | 28,400 |
| | 25' | 76° | 94' 3" | 34,280 | 13,930 | 20,990 |
| | 30' | 73° | 92'10" | 26,090 | 10,710 | 16,370 |
| | 35' | 69° | 91' 1" | 20,800 | 8,500 | 13,220 |
| | 40' | 66° | 89' 0" | 17,120 | 6,880 | 10,940 |
| | 45' | 62° | 86' 7" | 14,410 | 5,650 | 9,200 |
| | 50' | 59° | 83' 9" | 12,330 | 4,680 | 7,840 |
| | 55' | 55° | 80' 6" | 10,690 | 3,900 | 6,740 |
| | 60' | 51° | 76' 8" | 9,350 | 3,250 | 5,840 |
| | 65' | 47° | 72' 4" | 8,250 | 2,710 | 5,080 |
| | 70' | 42° | 67' 2" | 7,320 | 2,250 | 4,440 |
| | 75' | 37° | 61' 2" | 6,530 | 1,850 | 3,880 |
| | 80' | 31° | 53' 9" | 5,840 | 1,510 | 3,400 |
| | 85' | 24° | 44' 5" | 5,240 | 1,200 | 2,980 |
| | 90' | 15° | 30' 7" | 4,720 | 930 | 2,610 |
| 100' | 20' | 80° | 105' 6" | 48,580 | 18,710 | 28,090 |
| | 25' | 77° | 104' 6" | 34,030 | 13,600 | 20,670 |
| | 30' | 74° | 103' 3" | 25,810 | 10,390 | 16,060 |
| | 35' | 71° | 101' 9" | 20,530 | 8,180 | 12,910 |
| | 40' | 68° | 99'11" | 16,840 | 6,560 | 10,620 |
| | 45' | 65° | 97' 9" | 14,130 | 5,330 | 8,890 |
| | 50' | 62° | 95' 3" | 12,040 | 4,360 | 7,520 |
| | 55' | 59° | 92' 5" | 10,400 | 3,580 | 6,420 |
| | 60' | 55° | 89' 2" | 9,060 | 2,930 | 5,520 |
| | 65' | 52° | 85' 6" | 7,950 | 2,390 | 4,760 |
| | 70 | 48° | 81' 4" | 7,020 | 1,930 | 4,120 |
| | 75' | 44° | 76' 6" | 6,220 | 1,530 | 3,570 |
| | 80 | 40° | 70'11" | 5,540 | 1,190 | 3,090 |
| | 85 | 35° | 64' 5" | 4,940 | 880 | 2,670 |
| | 90' | 30° | 56' 6" | 4,410 | 620 | 2,290 |
| | 95 | 23° | 46' 6" | 3,950 | 380 | 1,960 |
| | 100' | 15° | 31'11" | 3,530 | 160 | 1,660 |

④ **Lifting** capacities shown are not more than 85% of minimum tipping loads **with** machine standing on firm level ground. A deduction must be made **from** the above lifting capacities for weight of hook block, hook, sling, **grapple**, etc.

① **The** heavy duty retractable high gantry is standard on the HO—3A and is **used** with standard angle booms up to and including 100' and with optional **tubular** "Hi-Lite" booms up to and including 130'. Tubular booms over **130'** also require the "Hi-Lite" boom gantry with mid-point suspension cables①. **The** "Hi-Lite" boom gantry can also be purchased as optional extra for all **tubular** booms under 130'. (Reference to boom lengths are for main boom **—use** of optional 20', 30' 40' and 50' Jibs with these boom lengths will not **effect** the recommendations.)

⑤ **With** 4-axle carrier, lifting capacities "without outriggers—over rear" can **be** increased 10% but not to exceed 80,000 lbs.

**B R I E F   S P E C I F I C A T I O N S**

**LIFTING CRANE**

Approximate working weight with 40' standard angle boom, heavy duty retractable high gantry, gasoline engine, but no hook blocks with:

Standard 3-axle carrier ........................82,680#

Optional 4-axle carrier ........................85,390#

Front or Rear drum single line speeds and pulls:

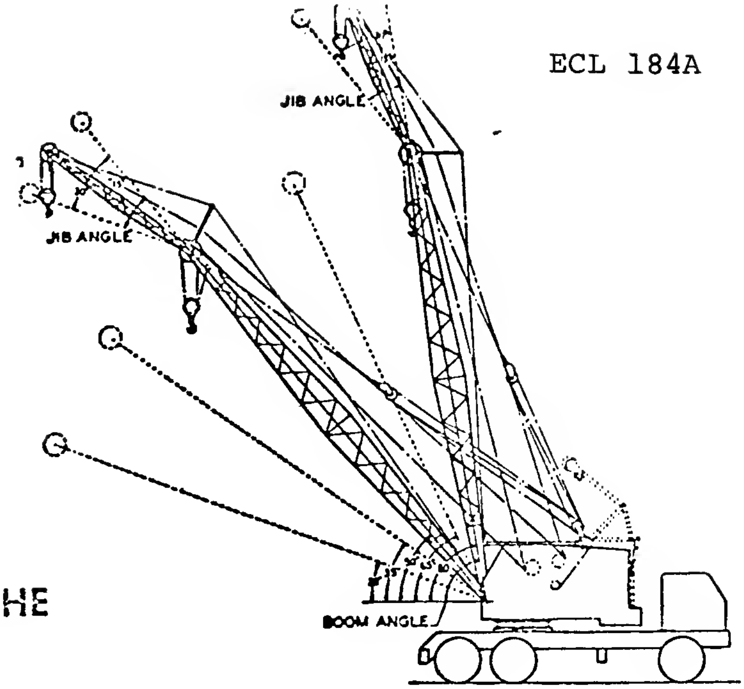
Hoist Line—13¼" lagging (Standard)—21,200# @ 139 f.p.m.

Hoist line—15¼" lagging (Optional)—18,500# @ 159 f.p.m.

Swing speed ..................................3.9 r.p.m.

EXHIBIT A-2

# ANGLE JIB CAPACITY RATINGS FOR THE HO – 8A




## THIS JIB CAN ONLY BE USED WITH THE STANDARD ANGLE BOOM

| | BOOM ANGLE TO GROUND | JIB IN LINE WITH BOOM | JIB 15° OFF CENTERLINE OF BOOM | JIB 30° OFF CENTERLINE OF BOOM |
|---|---|---|---|---|
| 20' JIB | 80° | 12,000 | 10,000 | 8,000 |
| | 65° | 10,500 | 9,000 | 7,500 |
| | 50° | 10,000 | 8,000 | 7,500 |
| | 35° | 8,500 | 8,000 | 7,500 |
| | 20° | 8,500 | 8,000 | 7,500 |
| 30' JIB | 80° | 10,000 | 8,000 | 6,000 |
| | 65° | 8,500 | 7,000 | 5,500 |
| | 50° | 8,000 | 6,000 | 5,500 |
| | 35° | 6,500 | 6,000 | 5,500 |
| | 20° | 6,500 | 6,000 | 5,500 |
| 40' JIB | 80° | 8,000 | 6,000 | 4,000 |
| | 65° | 6,500 | 5,000 | 3,500 |
| | 50° | 6,000 | 4,000 | 3,500 |
| | 35° | 4,500 | 4,000 | 3,500 |
| | 20° | 4,500 | 4,000 | 3,500 |

1. Maximum capacity of jib is as shown regardless of boom length.
2. These capacities apply only when loads are within the safe lifting capacity of the machine.
3. The operating radius is determined by the distance from the machine centerline of rotation to the load whether off the main boom peak or the jib peak sheave.
4. When determining the jib capacity for a given radius, add the length of boom being used to the length of the jib. Then refer to our crane lifting capacity charts and assume this total length of boom and jib, to be the length of boom used in the table for the radius required.
   - (a) For a 20' jib use this total length of boom and jib to obtain the lifting capacity at the operating radius from the crane lifting capacity chart.
   - (b) For a 30' jib use same procedure as 4(a), adding 150 lbs. to the capacity shown on the crane lifting capacity chart.
   - (c) For a 40' jib use same procedure as 4(a), adding 250 lbs. to the capacity shown on the crane lifting capacity chart.
5. When operating off the main boom peak sheaves but with a jib on the boom the following reductions in crane lifting capacities should be made.
   (a) 1,600 lbs. for the 20' jib. (b) 1,900 lbs. for the 30' jib. (c) 2,200 lbs. for the 40' jib.

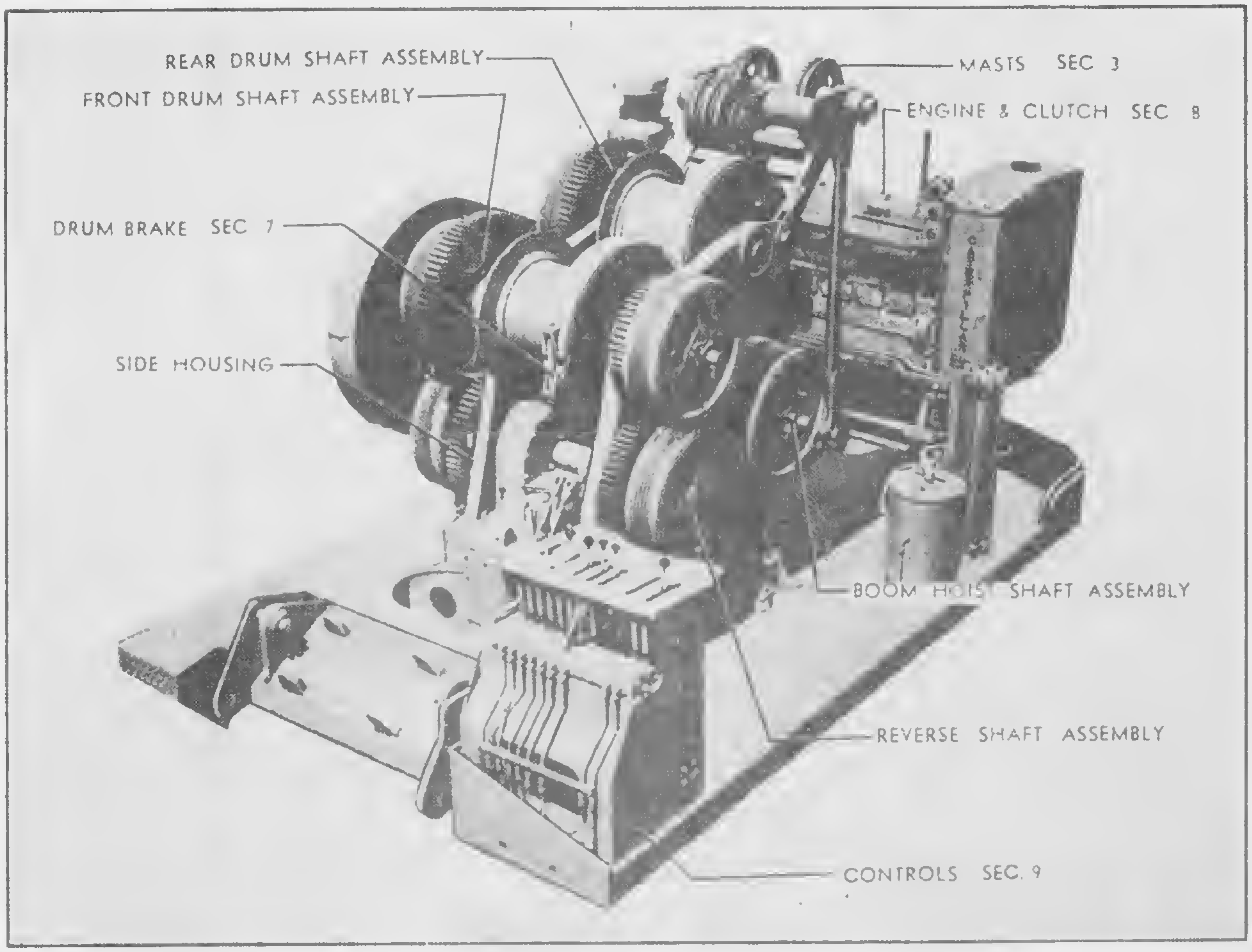



EXHIBIT A-3

Horizonal Shaft Assemblies


EXHIBIT A-4

Control Panel in the Crane Cab

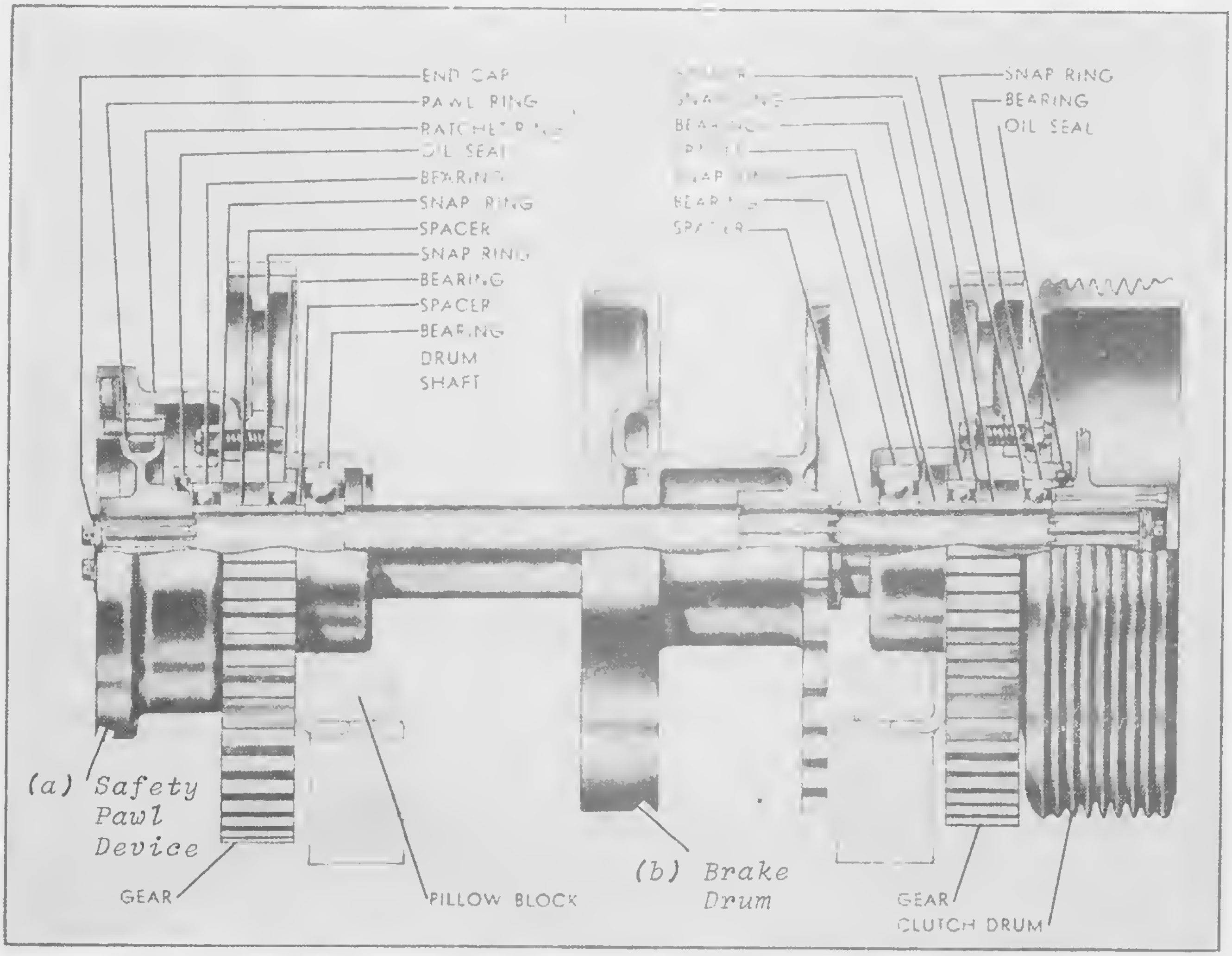



EXHIBIT A-5

Boom Hoist Shaft Assembly

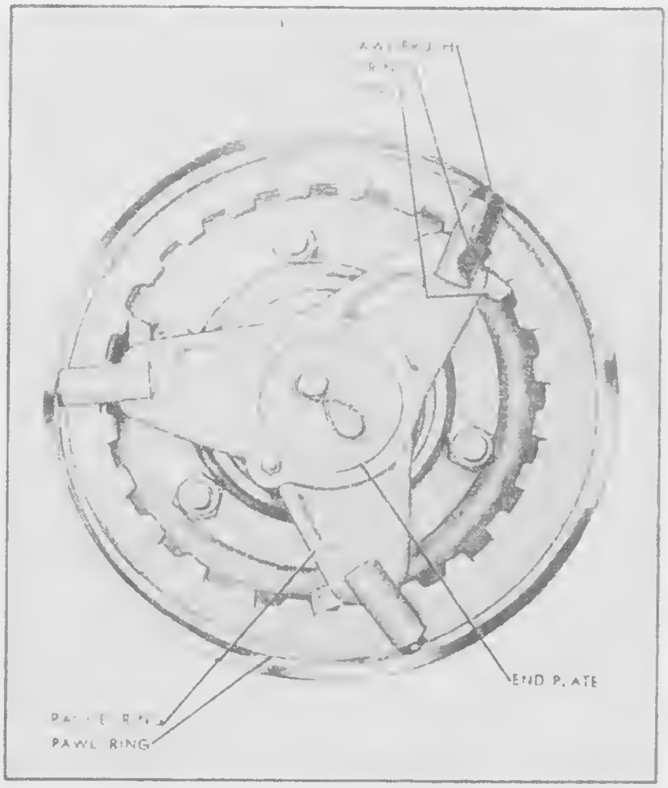



EXHIBIT A-6

Ratchet Pawl Assembly - End View

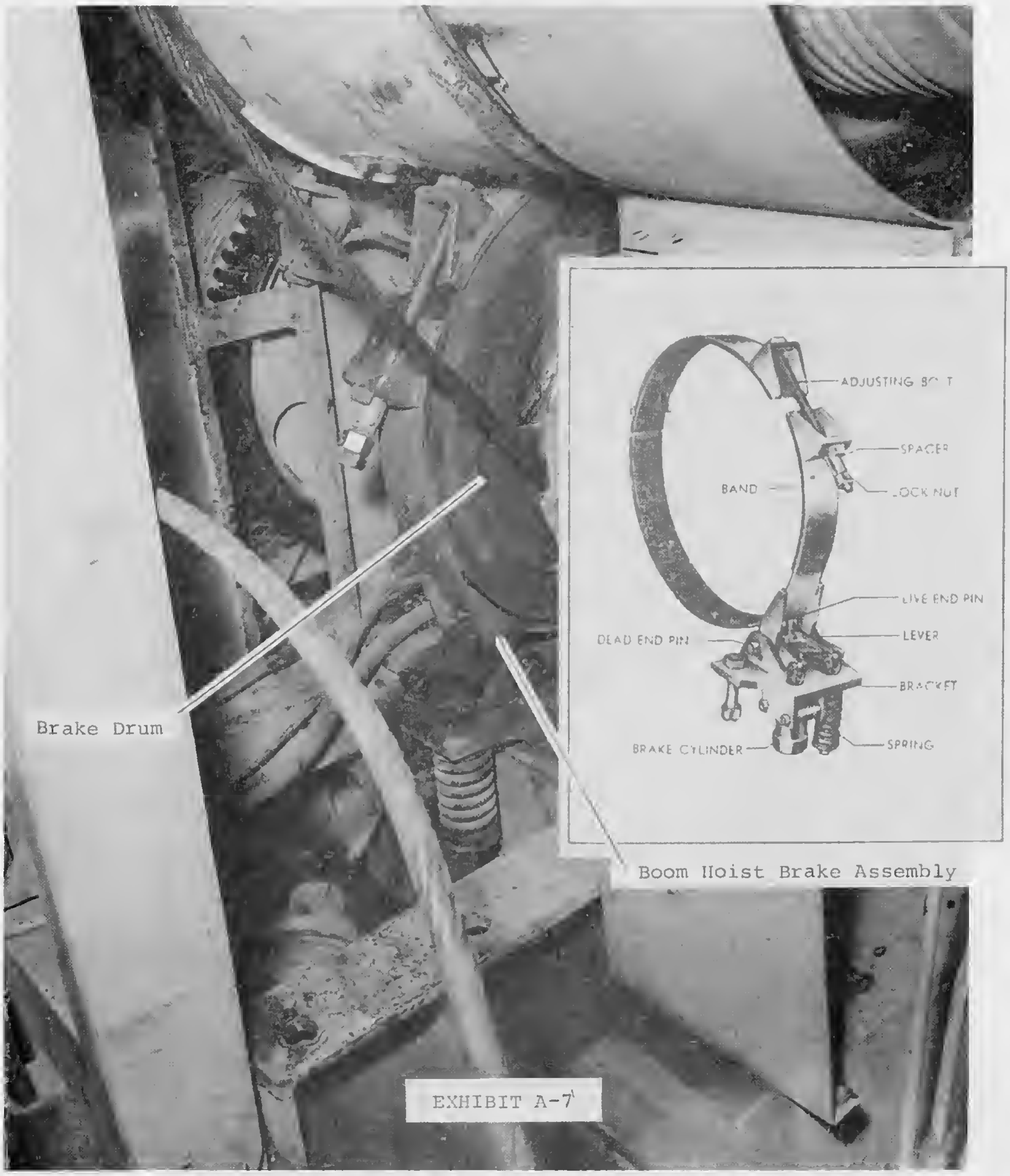

ADJUSTING
SPACER
BAND
LOCK NUT
LIVE END PIN
DEAD END PIN
LEVER
BRACKET
BRAKE CYLINDER
SPRING
Brake Drum
Boom Hoist Brake Assembly

EXHIBIT A-7

# ARNOLD WARE'S CRANE ACCIDENT (B)

As a consequence of injuries incurred in a crane accident, a law suit was filed by the victim, Mr. Arnold Ware. Mr. Goodman and his associates, attorneys representing Mr. Ware, took depositions from the various parties connected with this accident and made a motion for summary judgment. Cloverdale Crane and Rigging Company was charged with negligence. This part relates salient events and proceedings in the final settlement of the case.

# ARNOLD WARE'S CRANE ACCIDENT (B)

Mr. Richard Goodman and his associates, specialists in law suits involving industrial accidents, were the attorneys who represented Mr. Arnold Ware in this suit of negligence. In the pre-trial period of a civil case like this one, an attorney obtains information to build up his case from interviews with not only his party and parties related to his client, but he also 'deposes' members connected with the opposite side who may have pertinent information. The deposition procedure consists of interrogation of an individual party under oath, by the interested attorney in the presence of lawyers of the party being deposed and other lawyers if more than two parties are involved. For example, Mr. Goodman may depose an official of the Cloverdale Crane & Rigging Company. The function of CC & RC's lawyer in this case would be to protect the interests of his client. A court reporter is also present during these interrogations to take down what is said. The facts obtained in these depositions are used during the trial.

Depositions generally proceed in a manner somewhat similar to the questioning of a witness on the stand in a courtroom. Excerpts from Mr. Charles A. Brolin's deposition in which he is questioned by Mr. Richard Goodman are presented here as examples.

* * * *

Question. (Mr. Goodman): Will you state your full name, please, and your business and residential address?

Answer: Charles A. Brolin, Hans Roverson Crane Company, 1201 Sixth Street, S. W., Atlanta, Georgia.

Q: Home Address?

A: 1100 30th Street, S. E., Atlanta, Georgia.

Q: And your age?

A: Thirty-four.

Q: And your title?

A: Supervising engineer, laboratory.

Q: And how long have you held that job?

A: I would say about 8 years, 7 to 8 years.

Q: That is with Hans Roverson Crane Company here in Atlanta?

A: Yes.

Q: What is your academic background?

A: B.S. in Mechanical Engineering

Q: Where?

A: Georgia Tech.

Q: When?

A: '57.

Q: Give us a brief description of your work as lab supervisor for Roverson Crane Company?

A: I supervised the activity of the lab and the men therein, and we deal in such aspects of the operation as materials, material selection, material specifications, heat treatment, heat treatment specifications, tooling for heat treatment, experimental analysis, experimental testing, consultation, and service to the operating department, such as service on maintenance or assembly relating to similar problems. In a nutshell we are a service organization within the corporation.

Q: Who is your immediate supervisor?

A: Robert Thune, Chief Engineer.

Q: And how many people do you have working in the lab?

A: Myself and five others.

Q: What is your background in metallurgy?

A: What I obtained as an adjunct to my mechanical engineering curriculum at Georgia Tech, plus additional interest and extra courses beyond the requirements . . .

. . . . . .

Q: You were asked by the company to analyze the bolt and the brake assembly involved in the crane, which was part of this accident?

A: Yes.

Q: And who asked you to do that?

A: Mr. Strnad*

Q: This wasn't the first such test and analysis you made, was it?

A: No.

Q: Were you given any written protocol to follow in the course of carrying out your examination?

A: No. It is my responsibility to look at it and determine to the best we can.

Q: In other words, they say "here are the parts, we want to know what happened"?

A: True . . .

. . . . . .

Q: You mean you didn't check - strike that. What are your dimensions on this bolt?

A: May I quote the drawing?

Q: Certainly.

A: It is 3/4 inch, 12-1/2 inches long, 16 national fine thread, and it is approximately 12-1/2 inches long.

Q: Does that seem to be the dimensions of the bolt you examined?

A: I believe it is.

Q: Was it painted?

A: I don't believe it is painted.

Q: Describe any other findings with regard to this bolt that you made on visual examination?

A: The mode of failure appears to be fatigue.

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*Vice-President for Engineering, Hans Roverson Crane Company.

Q: Well, first of all, you noticed that there was a failure in the bolt?

A: Yes, it is in two pieces.

Q: And where is the fracture line?

A: At the junction between the head of the bolt and the shank.

Q: All right. And incidentally, were the nuts attached to the bolt when you got it?

A: I believe they were . . .

. . . . . .

Q: In all probability this is a Roverson Crane bolt?

Mr. LIVINGSTON:* Object to the question as being argumentative, calling for conclusion. We are not asking for probabilities.

Mr. GOODMAN: Let me put it another way.

Mr. LIVINGSTON: Roverson Crane doesn't make bolts anyway.

Mr. GOODMAN: I understand that.

Q: Let me ask you this, would you say that it is more likely than not that this originally was a bolt used on and assembled into a Roverson Crane brake hoist mechanism?

Mr. LIVINGSTON: Object to the question as calling for conclusion and speculation and conjecture.

Mr. GOODMAN: Well, if he can answer it. I'm not asking for conjecture. I'm just asking for more likely than not, fifty-one per cent as opposed to forty-nine per cent.

Mr. LIVINGSTON: You can answer what your guess is.

THE WITNESS: May I answer it in this manner, if we were to pick the bolt up off the floor or in the street and check the thing, and the fellow asked us, "can I put this in and meet your specifications"?, it would look like it would meet it and therefore could be used. As far as identifying it, that we put it in with the equipment, I certainly can't . . .

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*Attorney appearing on behalf of the Defendant, Hans Roverson Crane Company.

Q: Was there anything unusual about the spring mechanism whatsoever that you noticed?

A: The spring mechanism?

Q: Yes, the spring. How many springs were there, first of all?

A: In the material returned to us, there were two springs.

Q: And is that called for - strike that. Is that the way your brake is set up, with two springs?

A: No. Our standard assembly uses only one spring.

Q: All right. How are these springs mounted?

A: There was an extra located on the inside of our standard spring, or what appears to be our standard spring.

Q: Referring to photograph No.3* which is furnished to me by counsel, Mr. Livingston, showing the spring in a partly disassembled position, the large spring is your standard spring?

A: It appears to be our standard spring.

Q: And the smaller spring adjacent to it, that is not part of your standard assembly?

A: No, sir.

Q: Was that spring housed inside of, was the smaller spring housed inside the larger spring?

A: Yes, that is what one of the prior photographs shows.

Q: What is the purpose of the smaller spring?

A: I'd be guessing why it is in there. I could speculate why it is in there, but as far as in the standard product, there is no extra spring there.

Q: What is your speculation?

A: He wanted more braking effort than we wanted to give him possibly.

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*This photograph of two springs is not included in the case.

Q: More braking effort, what do you mean by that?

A: As was related, the spring is the mechanical device which energizes the brake, and if you want more effort, if you have more braking effort, you have got to have more spring, and it may have been someone's opinion on how to get more braking effort by inserting an extra spring . . .

. . . . . .

Q: Okay. Now, what is adding a smaller spring inside the larger spring do to the function of the spring, specifically in the brake, generally?

A: The cylinder, as I recall the mechanism, can actually only extend out of the body of the cylinder a certain distance, a maximum distance. In other words, that means that is the maximum stroke on the cylinder. Now, if we introduce an additional spring inside the main spring, what appears to be our spring, take the end casing, the center of the spring on the clevis rod and adjust a combination of two springs to a specific dimension, the stored energy in the combined springs will be greater than that in only one spring, and in that preload position, which is the position for energizing the brake, you have more live end pull than you should have by design, in other words, in a standard product. You would have more live end pull available than on a standard machine.

Q: Would that make for a faster and easier brake application?

A: I don't know about easier. It would appear that it might be faster and certainly the maximum effort available would be greater as a result of it.

Q: And what would be the effect on the component parts of the brake in terms of stress, if any?

A: As I understand the brake, the amount of resisting torque you can develop is the function of the live end pull, with more live end pull you can resist more torque, and so if there is more spring effort available, I would presume that you would have more live end pull and hence more braking effort than without it, in this case with the extra spring.

Q: Would that increase or decrease the stress on the bolt that connects the brake band?

A: It would increase the bolt load.

Q: Increase the stress on the bolt?

A: Increase the bolt load or the stress on the bolt.

Mr. STEFANI:* Just a minute so I don't lose that. Do you mean the inclusion of ths smaller spring in the larger spring would increase the stress on the bolt?

WITNESS: Yes.

Mr. GOODMAN: By a factor of what?

WITNESS: Now, I really should waive here because this is a design aspect and I haven't gone through those figures myself and I don't know if I can answer that.

Q: Give us an approximation in your own mind?

A: Without benefit of the figures, I think I'd be giving you a bum steer . . .

. . . . . .

Mr. GOODMAN: As far as you know, does your company recommend or advise the use of the supplementary spring in connection with a brake assembly?

WITNESS: I'm positive we do not.

Q: And why not?

A: Our drawings are the bible and the design group designed the thing to work and that is the best, the specifications on the drawings are the limits to which the machine is used.

Q: Here the addition of the supplementary spring provides a faster application of the brake. Isn't that desirable?

A: It might be to a specific customer, but I don't know if that is desirable for the bolt.

Q: You are talking about the bolt that holds both parts of the brake band together?

A: Yes.

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*Attorney appearing on behalf of Hartford Accident and Indemnity Company.

Q: The one that failed in this case?

A: Yes.

Q: What are your specifications on the spring part of the brake mechanism?

A: I don't have that information with me.

. . . . . .

Q: All right. Now, did you make an examination of the brake band itself?

A: Visual.

Q: Did you see anything - strike that. Were you able to identify anything unusual with the brake band or abnormal about it?

A: One thing that comes to mind is that the brake band had been modified by flame cutting on the dead end.

Q: What would have been the purpose for that?

A: If I might speculate, the maintenance of the machine possibly had not been the best, and as a result and he had lost adjustment and the proper range and rather than correct the problem, he removed part of the band, which normally would not cause interference, but may have been causing him interference, and to let's say further aggravate a maladjustment condition.

Q: You mean part of the band had been cut off?

A: Yes.

Q: How would that affect the stress on the bolt that failed, if at all?

A: Well, if there was interference and he removed it so that he could tighten these two springs beyond recommendations, then this would increase the live end pull as did the small additional spring inside our big spring, and that, in turn, of course, would allow you to run higher stresses on the bolt as a result of the live end pull. . .

. . . . . .

Q: And from examining the surfaces of the failure, the fracture rather, you were able to determine that this was in essence a fatigue failure?

A: Yes. I would say it is.

Q: And this you are able to tell simply by the nature of the surface itself?

A: Yes.

Q: And this is a typical surface that one sees when a fatigue failure has occurred?

A: Yes.

Q: And that tells us how and why, describe your idea of a fatigue failure surface . . from a metallurgical point of view?

A: Fatigue failures are characterized in their fracture surfaces by markings which are called beach marks, and these beach marks are evidenced on visual examination in motion machinery parts. Now, all machinery parts may not exhibit this, but ones that progress at a very slow rate do exhibit beach marks, and in addition to that, varying load over the life of the part helps to make these marks evident. The marks apparently result from a crack which initiates a very small initiation point, possibly a very small crack, possibly due to gross overloading, possibly due to just extremely long life under normal loading, then this crack tends to propagate under additional load and as a result there will be slight oxide films built up on this exposed metal.

Q: And possibly it will sit there and not crack for many days or at least many cycles?

A: And an additional load of one magnitude will cause this crack to propagate again a small distance, expose metal, which in turn oxidizes and leaves another mark. This is the primary means by which beach marks are left in a fatigue failure.

Q: They are characterized by a long term, slow propagating type crack?

A: (No answer)

Q: Are you familiar with the term "clam-shell pattern"?

A: I guess the clam came over the same beach.

Q: How long would you say this fracture took to develop and cause failure, over what period of time are we talking about?

A: I would guess a rather long period of time. As far as days or weeks or months, it is very difficult for me to say what it might be. I would guess at least, and I am guessing, purely, unless you don't want me to guess if you don't allow guesses.

Mr. LIVINGSTON: Just answer, well, we don't allow guesses.

Mr. GOODMAN: Well, you know that this didn't occur in a day, don't you?

THE WITNESS: Oh, I am quite sure it did not cccur in a day.

. . . . . .

An example of the cross examination of Mr. Brolin by Mr. Pillsbury, attorney representing the defendant, Cloverdale Crane and Rigging Company, follows:

Q: You mentioned that a section of the band brake was cut out by an acetylene torch?

A: Yes. It appeared to be.

Q: And welded back together?

A: No. It was just cut out and gone. I mean it was removed and gone.

Q: Well, this was from the fixed end though, wasn't it?

A: Yes.

Q: From the dead end. Well, the dead end is attached to something else, isn't it?

A: The dead end has a pin common to the bell crank and the bracket which anchors the dead end.

Q: Oh, is the dead end also the live end?

A: No.

Q: I thought the live end was the end that moved?

A: That is right.

Q: Well, if the live end moves, then the dead end is affixed to something else, isn't it?

A: Yes, but the bell crank is in between these members and if you want to go past where you are supposed to, you have to clear the obstruction, and he cut out so he could go past apparently. In other words, he was creating his own clearance.

Q: I see the picture . . .

. . . . . .

A list of the parties deposed in this case is given in Exhibit B-1

Based on the findings of these pre-trial depositions, Mr. Goodman prepared a motion for summary judgment. The attorney moving for a summary judgment, Mr. Goodman in this case, claims that the depositions present sufficient evidence to sustain a judgment in his favor and that his opponent does not show such facts as may be deemed by the judge hearing the motion sufficient to present a triable issue. Mr. Goodman presented the following "uncontroverted" facts in support of his summary judgment move:

1. The CC & RC used a crane boom and jib which exceeded the manufacturer's recommendations by some 20 per cent.

2. The CC & RC made radical alterations in the boom brake assembly.

3. The CC & RC employee failed to use the safety pawl as recommended by the manufacturer and as is required by the General Industrial Safety Orders.

4. He also presented arguments to dispute the claim that Mr. Ware contributed to the accident by his own negligence.

Details from Mr. Goodman's motion are given here:

*I. <u>Defendant Cloverdale Crane and Rigging's Negligence</u>:*

*Defendant Cloverdale Crane and Rigging used an unsafe and excessively long boom on the crane on the date of the accident. At the time of the Plaintiff's accident, the Defendant was using the crane with a boom and jib attachment which exceeded the manufacturer's specifications. As is*

*seen in Appendix A, the length of the boom used to determine the crane's lifting capacity is the sum of the lengths of the main boom and the length of the jib attachment. In this case, that was 90 ft. and 30 ft. respectively, for a total length of 120 ft. (Daves Dep., p. 6). This length is 20 ft. longer than the longest boom length recommended by the crane manufacturer, Hans Roverson Crane Company (See Appendix A, page 2*). This fact is confirmed by a letter from Mr. Rowand (Sales Manager of Roverson Crane Company) to Warnock-Bancroft Equipment Company, dated April 23, 1958:*

> *I wish to confirm my telephone conversation with you of Tuesday afternoon, April 22, pertaining to the maximum length of boom recommended on the HO - 8A's, as ordered by Pacific Crane & Rigging Company.*
>
> *The maximum length which we recommend is 100 ft. . . .*
>
> *(Dep. of Hanse, pp. 15-16)*

*II. <u>Negligent and Improper Boom Brake Assembly and Adjustment by Defendant, Cloverdale Crane and Rigging Company:</u>*

*While Cloverdale Crane and Rigging owned the crane in question, they made radical alterations in the boom brake assembly. The Defendant altered the boom brake in the following ways:*

*A. The Defendant placed a second spring into the brake assembly to increase the pull or tightness of the brake bands as they are wrapped around the brake drum. They actually added a second spring to the one designed into the system by Hans Roverson Crane Company (See Appendix C, Fig. 5-8)** (Brolin Dep., pp. 22-27).*

*B. The Defendant, Cloverdale Crane & Rigging Company, cut off a piece of the brake band. After this was done, the brake bands could be adjusted well beyond the positions intended by the manufacturer (Brolin Dep., pp. 29-30).*

*Both of these adjustments introduced braking or restraining torques well in excess of those provided by the manufacturer. Both of these adjustments would allow the brake bands to be wrapped or stretched around the brake drum with great pull or force (Brolin Dep., pp. 27, 30-32).*

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*Exhibit A-2

**Exhibit A-7

*Consequently, when this increased force or pull was introduced into the system to wrap the two bands around the brake drum, the bolt which held these bands together was loaded beyond its designed capacity.*

*These adjustments were made by agents of Cloverdale Crane and Rigging Company. Mr. Daves testified in his Deposition that the brake band in question had been placed on the crane approximately five months before the accident. He stated that he knew this was done in Los Angeles before the crane was transferred to the San Diego Branch. (Daves Dep., pp. 22-23)*

*III. Defendant Cloverdale Crane & Rigging Company Failed to Use the Boom Dog at the Time of Plaintiff's Accident to Prevent the Boom from Falling on the Plaintiff.*

*The boom dog is a back-up brake to the main boom brake which is controlled by the operator. The failure of the Defendant's operator to employ the boom dog or safety pawl while operating the crane constituted negligence.*

*California Administrative Code, Title 8, General Industry Safety Orders §4002 reads as follows:*

> *When a load of any kind is to be suspended for any considerable time, the dog or pawl, if one is provided shall be used in addition to the brake which shall also be applied.*

*The failure of the Defendant's operator to use the boom dog on the crane in question constitutes a violation of this safety order.*

*On the morning in question, the operator used the crane in such a fashion so that he neither had to boom up or boom down to perform the required transporting operation. The point at which the cement was picked up and the point where it was dumped were equidistant from the crane. Therefore, all the operator had to do was crane (rotate) the crane around and adjust the height of the load line (Daves Dep., pp. 12-13). The crane had been operating in this fashion five to ten minutes before the accident (Daves Dep., p. 62). Not only does the State of California require the use of the safety pawl, but its use is specifically required by the Roverson Crane Company Operator's Manual, Page 15-2, which reads as follows:*

> *Boom Hoist Pawl Control operates a boom hoist safety device. Pulling out this knob disengages the boom hoist pawl thus allowing the boom to be lowered. This control should be engaged at all*

*times for safe operation except when booming down. This pawl prevents the boom from falling out of control should the boom hoist brake fail.*

*The use of this device is recommended by the manufacturer to prevent the very type of accident which occurred in the case at bar. (Strnad Dep., pp. 64-65)*

## *IV. Plaintiff's Contributory Negligence*

*It is claimed by the Defendant that the Plaintiff was contributorily negligent. Plaintiff contends that this defense is unfounded on the facts of the case.*

*On the morning in question:*

*A. Plaintiff was working on the surface of the bridge. (Daves Dep., pp. 14-16)*

*B. He was wearing his hard hat. (Daves Dep., p. 67)*

*C. Plaintiff was spreading cement and helping to dump the buckets as they were swung onto the bridge. (Daves Dep., p. 15)*

*D. Between each dump, the laborers who were working on the bridge had to spread in a rapid fashion the concrete and perform other assigned tasks before the next bucket was swung over onto the bridge. (Daves Dep., pp. 37 and 72)*

*E. There was a signal man on the bridge who kept the bucket under surveillance and signalled to the crane operator where to properly position the bucket. (Daves Dep., pp. 34 and 37)*

*F. Just before the boom fell, the Plaintiff was standing approximately three feet from where the bucket was to be dumped. (Daves Dep., p. 17)*

*When the Defendant CC & R's crane operator was queried about Plaintiff's conduct, he testified as follows:*

*Q: (Hofflund) Were they (the laborers on the bridge) doing anything that caused you any sense of alarm or concern at all before the accident?*

*A: No.*

*Q: As far as you were concerned, everything was normal?*

*A: Right (page 65)*

*Q: (Hofflund) The fact that he (Ware) was three feet from the point of the crop of the bucket, as you previously described, did not seem anything unusual or unduly hazardous under these circumstances, did it?*

*A: No. (pp. 68-69)*

*(Daves Dep., pp. 65, 68-69)*

*These facts speak for themselves in regard to any alleged lack of reasonable care by the Plaintiff at the time of the injury. Even Defendant's own crane operator of over 13 years experience, (Daves Dep., p. 60) did not believe the Plaintiff was doing anything that could possibly constitute negligence.*

The summary judgment move was made in May of 1968. As is not uncommon the case was settled outside the court by the two parties before a court hearing was scheduled. The final amount of settlement was approximately $150,000, paid mostly by Cloverdale Crane and Rigging Company.

## PRE-TRIAL DISCOVERY

In the course of pre-trial discovery, the following parties were deposed:

1. Arnold Ware was deposed on December 16, 1966 in Pacoima, California. Mr. Ware is the Plaintiff in this cause.

2. James H. Essick was deposed on September 6, 1966 in Los Angeles, California. Mr. Essick was founder, owner, and acting president of James H. Essick, d/b/a Cloverdale Crane and Rigging Company.

3. Mike Forman was deposed on February 3, 1967 in Los Angeles, California. Mr. Forman was Safety Engineer and Credit Manager for Cloverdale Crane and Rigging Company.

4. Vernon C. Filley was deposed on January 27, 1967 in San Diego, California. Mr. Filley was Branch Manager of Cloverdale Crane and Rigging's San Diego Branch. This was one of several branches of Cloverdale Crane and Rigging located at various points in Southern California and the branch from which the crane in question was dispatched.

5. Marvin E. Daves was deposed on July 18, 1966 in San Diego, California. Mr. Daves was the operator of the crane which was involved in Plaintiff's injury.

6. Lyle T. Hanse was deposed on September 9, 1966 in Cedar Rapids, Iowa. Mr. Hanse was Vice-President of Sales for Hans Roverson Crane Company.

7. Frank J. Strnad was deposed on September 9, 1966 in Cedar Rapids, Iowa. Mr. Strnad was Vice-President of Engineering for the Hans Roverson Crane Company.

8. Charles A. Brolin was deposed on September 9, 1966 in Cedar Rapids, Iowa. Mr. Brolin was the Supervising Engineer, Laboratory, for Hans Roverson Crane Company. He was the man in charge of a visual and engineering analysis of the brake mechanism which failed on the crane in question.

EXHIBIT B-1

9. Phillip J. Charley, Ph.D., was deposed on April 11, 1967 in Los Angeles, California. Dr. Charley was Vice-President of Truedail Laboratories, an independent testing laboratory, employed by Hans Roverson's insurance company to examine the brake which failed on the crane in question.

In addition to the above individuals being deposed, all of the parties have received copies of:

1. Various engineering drawings and specifications for various components of the Hans Roverson crane in question.

2. The Defendant Hans Roverson Crane Company Crane Operators Manual, Parts Manual and Service Manual.

3. Various sets of photographs that were taken of the scene of injury and of the crane in question by the various parties.

4. All sales documents and specifications and correspondence arising out of the sale of the crane in question.

5. The engineering report of Dr. Charley.

EXHIBIT B-1